

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application : **10/511,802**
Applicant(s) : **PANSIER, Frans**
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Title: **LLC HALF-BRIDGE CONVERTER**

Mail Stop: **APPEAL BRIEF - PATENTS**
Commissioner for Patents
Alexandria, VA 22313-1450

APPEAL UNDER 37 CFR 41.37

Sir:

This is an appeal from the decision of the Examiner dated 9 February 2007,
finally rejecting claims 2-5, 7-10, and 12-20 of the subject application.

This paper includes (each beginning on a separate sheet):

- 1. Appeal Brief;**
- 2. Claims Appendix;**
- 3. Evidence Appendix; and**
- 4. Related Proceedings Appendix.**

APPEAL BRIEF

I. REAL PARTY IN INTEREST

The above-identified application is assigned, in its entirety, to **Koninklijke Philips Electronics N. V.**

II. RELATED APPEALS AND INTERFERENCES

Appellant is not aware of any co-pending appeal or interference that will directly affect, or be directly affected by, or have any bearing on, the Board's decision in the pending appeal.

III. STATUS OF CLAIMS

Claims 1, 6, and 11 are canceled.

Claims 2-5, 7-10, and 12-20 are pending in the application.

Claims 2-5, 7-10, and 12-20 stand rejected by the Examiner under 35 U.S.C. 102(b).

These rejected claims are the subject of this appeal.

IV. STATUS OF AMENDMENTS

An amendment was filed subsequent to the final rejection in the Office Action dated 9 February 2007, canceling claims 1, 6, and 11.

V. SUMMARY OF CLAIMED SUBJECT MATTER

The invention addresses a 'general purpose' transformer design for resonant DC-DC converters. The transformer is created as a series connection of existing smaller transformers (Applicant's page 1, lines 27-28), thereby providing greater flexibility in physical arrangement (page 2, lines 16-25). To provide the intended power to the load, the secondary windings of each of the smaller transformers are coupled together, generally in a parallel arrangement so that the current to the load is the sum of the secondary currents (FIG. 3, page 6, lines 19-24). However, this

coupling of the secondary windings imposes constraints on the configuration to assure proper operation, particularly if one or more of the smaller transformers includes auxiliary windings for other loads, as would be typical of a general purpose DC-DC transformer. The applicant has determined that proper operation is assured when all transformers deliver current to the same load during substantially the same period of time such that the voltages over all the transformers are substantially equal (page 2, lines 24-30). This condition can be shown to be met when the total power supplied by every transformer is larger than the power supplied to the auxiliary windings (page 3, lines 1-2). Alternatively stated, if a first transformer provides a first auxiliary power and a first load power, and a second transformer provides a second auxiliary power and a second load power, proper operation is assured if the first auxiliary power minus the second auxiliary power is less than the first load power, and if the second auxiliary power minus the first auxiliary power is less than the second load power (page 3, lines 5-13). In this manner, the design task for creating a DC-DC power supply with multiple outputs is simplified to arranging a series of (existing) smaller transformers and distributing the loads accordingly to the outputs.

Independent claim 2 recites a resonant LLC power converter comprising at least two transformers (FIG. 4), wherein:

primary windings (LM1, LM2) of the at least two transformers (T1, T2) are coupled in series (page 7, lines 1-5),

each one of the at least two transformers (T1, T2) includes a secondary winding (W1, W2) for supplying a non-zero current to a common load (LO) during a substantially same period of time (page 7, lines 15-19),

the first transformer includes a first predetermined number of further secondary windings (WA1) for supplying a first total power to associated loads (LA1) (page 7, lines 14-15), and

the first total power is less than the power supplied by the secondary winding (W2) of the second transformer (T2) to the common load (LO) (page 7, lines 19-20).

Independent claim 9 recites an electronic apparatus comprising a resonant LLC power converter with at least two transformers (T1, T2), wherein (FIG. 4):

primary windings (LM1, LM2) of the at least two transformers (T1, T2) are coupled in series (page 7, lines 1-5),

each one of the at least two transformers (T1, T2) includes a secondary winding (W1, W2) for supplying a non-zero current to a common load during a substantially same period of time (page 7, lines 15-19), and

one or more transformers (T1, T2) of the at least two transformers includes one or more additional secondary windings (WA1, WA2) that are configured to supply non-zero current to ancillary loads (LA1, LA2) (page 7, lines 14-15).

Independent claim 15 recites a resonant LLC power converter comprising (FIG. 3):

a resonance capacitor (CR),

a series arrangement of a first electronic switch (S1) and a second electronic switch (S2) for receiving a direct current input voltage (VAB) (page 5, lines 24-26),

a first transformer (T1) that includes a primary winding (LM1) and a secondary winding (W11) that is coupled via a first rectifier circuit (D11) to a load (LO) for supplying current (I1) to the load (LO) during a conductive period of the first rectifier circuit (D11) (page 5, lines 31-32; page 6, lines 3-4),

a second transformer (T2) that includes a primary winding (LM2) and a secondary winding (W21) that is coupled via a second rectifier circuit (D21) to the load (LO) for supplying current (I2) to the load (LO) during a conductive period of the second rectifier (D21) (page 5, line 32; page 6, lines 7-8),

wherein the primary winding (LM1) of the first transformer (T1), the primary winding (LM2) of the second transformer (T2) and the resonance capacitor (CR) are arranged in series across the second electronic switch (S2) (page 5, line 31 – page 6, line 2), and

the primary winding (LM1) of the first transformer (T1) and the primary winding (LM2) of the second transformer (T2), and the first rectifier circuit (D11) and the

second rectifier circuit (D21) being poled to obtain a substantially coincidence of the conductive period of the first rectifier circuit (D11) and the conductive period of the second rectifier circuit (D21) to obtain a first voltage (VP1) across the primary winding (LM1) of the first transformer (T1) being substantially equal to a second voltage (VP2) across the primary winding (LM2) of the second transformer (T2) during the conductive period of the first rectifier circuit (D11) (page 6, lines 19-29).

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Claims 2-5, 7-10, and 12-20 stand rejected under 35 U.S.C. 102(b) over Telefus et al. (USP 5,694,304, hereinafter Telefus).

VII. ARGUMENT

Claims 2-5, 7-10, and 12-20 stand rejected under 35 U.S.C. 102(b) over Telefus

MPEP 2131 states:

"A claim is anticipated only if *each and every element* as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). "The *identical invention* must be shown in as *complete detail* as is contained in the ... claim." *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989).

Also, the Board of Patent Appeals and Interferences has consistently upheld the principle that the burden of establishing a prima facie case resides with the Office, and to meet this burden, the Examiner must specifically identify where each of the claimed elements are found in the prior art:

"there must be no difference between the claimed invention and the reference disclosure, as viewed by a person of ordinary skill in the field of the invention. *Scripps Clinic & Research Found. v. Genentech, Inc.*, 927 F.2d 1565, 1576, 18 USPQ2d 1001, 1010 (Fed. Cir. 1991). To meet [the] burden of establishing a prima facie case of anticipation, the examiner must explain how the rejected claims are anticipated by pointing out where *all* of the specific limitations recited in the rejected claims are found in the prior art

relied upon in the rejection." *Ex Parte Naoya Isoda*, Appeal No. 2005-2289, Application 10/064,508 (BPAI Opinion October 2005).

Claims 2-5, 12-14

Claim 2, upon which claims 3-5 and 12-14 depend, recites a power converter that includes at least first and second transformers with secondary windings for supplying current to a common load, wherein the first transformer includes further secondary windings for supplying a first total power to associated loads, and the first total power is less than the power supplied by the secondary winding of the second transformer to the common load.

The Office action fails to show where Telefus teaches a power converter with two transformers with secondary windings for supplying current to a common load, wherein one of the transformers includes a further secondary windings for supplying a first total power to associated loads, and the Office action fails to show where Telefus teaches that the first total power is less than the power supplied by the secondary winding of the second transformer to the common load.

In the rejection of all of the applicant's claims, the Office action merely states that: "Telefus discloses two series connected primaries (tp1, Tp2) with a llc resonant type circuitry supplying a single nonzero output", followed by a copy of Telefus' FIG. 4.

The text of the Office action fails to identify where Telefus teaches that one of the transformers has two secondary windings, and Telefus' FIG. 4 clearly shows that each of the transformers T1, T2 has a single secondary winding. Correspondingly, the Office action does not address the power provided via a further secondary winding.

Because the Office action fails to identify where Telefus teaches each of the limitations of claim 1, and because Telefus fails to teach a combination of two transformers wherein at least one of the transformers includes multiple secondary windings, the applicant respectfully maintains that the rejection of claims 2-5 and 12-14 under 35 U.S.C. 102(b) over Telefus is unfounded, per MPEP 2131, and should be reversed by the Board.

Claims 7-10

Claim 9, upon which claims 7-8 and 10 depend, recites an electronic apparatus that includes at least two transformers with a secondary winding for supplying a non-zero current to a common load, wherein one or more of the transformers includes one or more additional secondary windings that supply current to ancillary loads.

As noted above, in the rejection of all of the applicant's claims, the Office action merely states that: "Telefus discloses two series connected primaries (tp1, Tp2) with a llc resonant type circuitry supplying a single nonzero output", followed by a copy of Telefus' FIG. 4.

The text of the Office action fails to identify where Telefus teaches that one of the transformers has a secondary winding and one or more additional secondary windings, and Telefus' FIG. 4 shows that each of the transformers T1, T2 has a single secondary winding.

Because the Office action fails to identify where Telefus teaches each of the limitations of claim 9, and because Telefus fails to teach a combination of two transformers wherein at least one of the transformers includes multiple secondary windings, the applicant respectfully maintains that the rejection of claims 7-10 under 35 U.S.C. 102(b) over Telefus is unfounded, per MPEP 2131, and should be reversed by the Board.

Claims 15-20

Claim 15, upon which claims 16-20 depend, claims a resonant LLC power converter that includes two transformers, wherein the primary winding of the first transformer, the primary winding of the second transformer, a first rectifier circuit, and a second rectifier circuit are poled to obtain a substantially coincidence of the conductive period of the first rectifier circuit and the conductive period of the second rectifier circuit to obtain a first voltage across the primary winding of the first

transformer that is substantially equal to a second voltage across the primary winding of the second transformer during the conductive period of the first rectifier circuit.

The Office action fails to show where Telefus teaches a first voltage across the primary winding of the first transformer that is substantially equal to a second voltage across the primary winding of the second transformer during the conductive period of the first rectifier circuit.

As noted above, in the rejection of all of the applicant's claims, the Office action merely states that: "Telefus discloses two series connected primaries (Tp1, Tp2) with a llc resonant type circuitry supplying a single nonzero output", followed by a copy of Telefus' FIG. 4.

The text of the Office action fails to identify where Telefus teaches that the primary voltages of each of the transformers are equal.

In Telefus' summary description of the configuration of FIG. 4, Telefus clearly teaches that the voltages across the two transformers are substantially different:

"In the embodiment shown, T1 is substantially smaller than T2, i.e., primary winding Tp1 has substantially fewer turns than primary winding Tp2, and the magnetic core of T1 is correspondingly smaller than the core of T2. As such, under light load conditions, the inductance L1 [of] T1, related to the number of turns of Tp2, is substantially greater than the inductance L2 of T2. Notably, primary windings Tp1 and Tp2, respectively, are connected in series and thus, conduct the same current I." (Telefus, column 11, lines 59-67.)

Because both transformers conduct the same current in their primary windings, and the primary windings have substantially different inductances, the voltage across each transformer will be substantially different.

Because the Office action fails to identify where Telefus teaches each of the limitations of claim 15, and because Telefus specifically teaches the use of transformers with substantially different primary inductances, and therefore primarily different primary voltages, the applicant respectfully maintains that the rejection of claims 15-20 under 35 U.S.C. 102(b) over Telefus is unfounded, per MPEP 2131, and should be reversed by the Board.

CONCLUSIONS

Because the Office action fails to show where Telefus teaches each of the elements of each of the applicant's independent claims, the applicant respectfully requests that the Examiner's rejection of claims 2-5, 7-10, and 12-20 under 35 U.S.C. 102(b) be reversed by the Board, and the claims be allowed to pass to issue.

Because Telefus fails to teach each of the elements of each of the applicant's independent claims, the applicant respectfully requests that the Examiner's rejection of claims 2-5, 7-10, and 12-20 under 35 U.S.C. 102(b) be reversed by the Board, and the claims be allowed to pass to issue.

Respectfully submitted

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CLAIMS APPENDIX

1 (Canceled).

2. A resonant LLC power converter comprising at least two transformers, wherein:
 - primary windings of the at least two transformers are coupled in series,
 - each one of the at least two transformers includes a secondary winding for supplying a non-zero current to a common load during a substantially same period of time,
 - the first transformer includes a first predetermined number of further secondary windings for supplying a first total power to associated loads, and
 - the first total power is less than the power supplied by the secondary winding of the second transformer to the common load.
3. The resonant LLC power converter of claim 2, wherein the second transformer includes a second predetermined number of further secondary windings for supplying a second total power to associated loads, wherein both the first total power minus the second total power is less than the power supplied by the secondary winding of the first transformer to the common load, and the second total power minus the first total power is less than the power supplied by the secondary winding of the second transformer to the common load.
4. The resonant LLC power converter of claim 3, wherein at least one of the first predetermined number of further secondary windings of the first transformer and an associated rectifier is poled for delivering power to at least one of the associated loads, during a half wave of a resonance current in the first transformer with a first polarity, and at least one of the predetermined number of further secondary windings of the second transformer and an associated rectifier is poled for supplying power to the at least one of the associated loads during a half wave of a resonant current in the second transformer with a polarity opposite to the first polarity.

5. The resonant LLC power converter of claim 2, including:

- a resonance capacitor, and
- a series arrangement of a first electronic switch and a second electronic switch for receiving a direct current input voltage,
- the at least two transformers comprising a first transformer having a primary winding and a plurality of secondary windings being coupled via a first rectifier circuit to a load for supplying current to the load during a conductive period of the first rectifier circuit,
- a second transformer having a primary winding and a secondary winding being coupled via a second rectifier circuit to the load for supplying current to the load during a conductive period of the second rectifier,
- wherein the primary winding of the first transformer, the primary winding of the second transformer and the resonance capacitor are arranged in series across the second electronic switch, and
- the primary winding of the first transformer and the primary winding of the second transformer, and the first rectifier circuit and the second rectifier circuit being poled to obtain a substantially coincidence of the conductive period of the first rectifier circuit and the conductive period of the second rectifier circuit to obtain a first voltage across the primary winding of the first transformer being substantially equal to a second voltage across the primary winding of the second transformer during the conductive period of the first rectifier circuit.

6 (Canceled).

7. The apparatus of claim 9, wherein the secondary windings are coupled in parallel to supply the non-zero current to the common load.

8. The apparatus of claim 9, wherein each of the transformers is configured to supply substantial equal non-zero current to the common load.

9. An electronic apparatus comprising a resonant LLC power converter with at least two transformers, wherein:

primary windings of the at least two transformers are coupled in series,
each one of the at least two transformers includes a secondary winding for
supplying a non-zero current to a common load during a substantially same period of
time, and

one or more transformers of the at least two transformers includes one or
more additional secondary windings that are configured to supply non-zero current to
ancillary loads.

10. The apparatus of claim 9, wherein each transformer of the at least two
transformers supplies a total current that is larger than a sum of all the currents to the
ancillary loads.

11 (Canceled).

12. The converter of claim 2, wherein:

a first transformer of the two transformers includes one or more additional
secondary windings that supply power to one or more associated loads of the first
transformer, and

a second transformer of the two transformers includes one or more additional
secondary windings that supply power to one or more associated loads of the second
transformer.

13. The converter of claim 12, wherein:

the first transformer provides a first amount of power to the common load, and a second amount of power to the associated loads of the first transformer,
the second transformer provides a third amount of power to the common load, and a fourth amount of power to the associated loads of the second transformer,
the first amount of power is greater than the fourth amount of power, and
the third amount of power is greater than the second amount of power.

14. The converter of claim 2, wherein

the two transformers are configured to supply a substantially equal current to the common load.

15. A resonant LLC power converter comprising:

a resonance capacitor,
a series arrangement of a first electronic switch and a second electronic switch for receiving a direct current input voltage,
a first transformer that includes a primary winding and a secondary winding that is coupled via a first rectifier circuit to a load for supplying current to the load during a conductive period of the first rectifier circuit,
a second transformer that includes a primary winding and a secondary winding that is coupled via a second rectifier circuit to the load for supplying current to the load during a conductive period of the second rectifier,
wherein the primary winding of the first transformer, the primary winding of the second transformer and the resonance capacitor are arranged in series across the second electronic switch, and
the primary winding of the first transformer and the primary winding of the second transformer, and the first rectifier circuit and the second rectifier circuit being poled to obtain a substantially coincidence of the conductive period of the first rectifier circuit and the conductive period of the second rectifier circuit to obtain a first voltage across the primary winding of the first transformer being substantially equal to

a second voltage across the primary winding of the second transformer during the conductive period of the first rectifier circuit.

16. The converter of claim 15, wherein the secondary windings of the first and second transformers are configured to supply the current to the load in parallel.

17. The converter of claim 15, wherein the first transformer includes one or more additional secondary windings that are configured to supply current to one or more ancillary loads.

18. The converter of claim 17, wherein the second transformer includes one or more additional secondary windings that are configured to supply current to one or more additional ancillary loads.

19. The converter of claim 18, wherein the first transformer is configured to provide an amount of the current to the load that is greater than an amount of current that the second transformer provides to the one or more additional ancillary loads.

20. The converter of claim 15, wherein the first and second transformers are configured to supply substantially equal current to the load.

EVIDENCE APPENDIX

No evidence has been submitted that is relied upon by the appellant in this appeal.

RELATED PROCEEDINGS APPENDIX

Appellant is not aware of any co-pending appeal or interference which will directly affect or be directly affected by or have any bearing on the Board's decision in the pending appeal.